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PATENT AND TRADEMARK OFFICEATTORNEY DOCKET NO.  
P107348-00041TRANSMITTAL LETTER TO THE UNITED STATES  
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CONCERNING A FILING UNDER 35 U.S.C. 371

DATE: September 14, 2000

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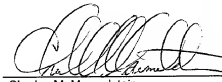
09/623481

INTERNATIONAL APPLICATION NO.  
PCT/JP99/00528INTERNATIONAL FILING DATE  
February 8, 1999PRIORITY DATE CLAIMED  
March 16, 1998

TITLE OF INVENTION: SEALANT-INCORPORATED TIRE MANUFACTURING METHOD AND SEALANT-INCORPORATED TIRE

APPLICANT(S) FOR DO/EO/US: Toshio YAMAGIWA

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.  
(THE BASIC FILING FEE IS ATTACHED)
  2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
  3. ☒ This express request to begin national examination procedures (35 U.S.C. 371(f)) at any time rather than delay examination until the expiration of the applicable time limit set in 35 U.S.C. 371(b) and PCT articles 22 and 39(1).
  4. ☒ A proper demand for International Preliminary Examination was made by the 19th month from the earliest claimed priority date.
  5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
    - a. ☒ is transmitted herewith (required only if not transmitted by the International Bureau).
    - b. ☐ has been transmitted by the International Bureau.
    - c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US)
  6. ☒ A translation of the International Application into English (35 U.S.C. 371(c)(2)).
  7. ☐ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
    - a. ☐ are transmitted herewith (required only if not transmitted by the International Bureau).
    - b. ☐ have been transmitted by the International Bureau.
    - c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
    - d. ☐ have not been made and will not be made.
  8. ☐ A translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
  9. ☒ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
  10. ☒ A translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).
- Items 11. to 16. below concern other document(s) or information included:
11. ☒ An Information Disclosure Statement under 37 CFR 1.97 and 1.98; PTO-1449 Form; References (2).
  12. ☒ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
  13. ☒ A FIRST preliminary amendment.  
☐ A SECOND or SUBSEQUENT preliminary amendment.
  14. ☒ Amended specification (32 pages).
  15. ☐ A change of power of attorney and/or address letter.
  16. ☒ Other items or information:  
CHECK NO. 500743; Drawings (20 sheets); Japanese and English Language PCT Request (PCT/RO/101); Japanese and English Language International Search Report (PCT/ISA/210); Japanese and English Language PCT Demand (PCT/PEA/401); Japanese Language PCT Opinion (PCT/IPEA/408); Japanese and English Language Amendment and Response filed in response to PCT Opinion; Japanese and English Language International Preliminary Examination Report (PCT/IPEA/409)

U.S. APPLN. NO. (IF KNOWN, SEE 37 C.F.R. 1.52) <b>09/623481</b>		INTERNATIONAL APPLICATION NO. PCT/JP99/00528		ATTORNEY DOCKET NO. P107348-00041	
				DATE: September 14, 2000	
17. <u>XX</u> The following fees are submitted: <b>Basic National Fee (37 CFR 1.492(a)(1)-(5)):</b> Search Report has been prepared by the EPO or JPO.....\$840.00 International preliminary examination fee paid to USPTO (37 CFR 1.482).....\$670.00 No international preliminary examination fee paid to USPTO (37 CFR 1.482) but international search fee paid to USPTO (37 CFR 1.445(a)(2)).....\$690.00 Neither international preliminary examination fee (37 CFR 1.482) or international search fee (37 CFR 1.445(a)(2)) paid to USPTO.....\$970.00 International preliminary examination fee paid to USPTO (37 CFR 1.482) and all claims satisfied provisions of PCT Article 33(2)-(4).....\$ 96.00				CALCULATIONS _____ PTO USE ONLY _____	
<b>ENTER APPROPRIATE BASIC FEE AMOUNT =</b>				\$	840.00
Surcharge of \$130.00 for furnishing the oath or declaration later than _ 20 _ 30 months from the earliest claimed priority date (37 CFR 1.492(e)).				\$	
Claims	Number Filed	Number Extra	Rate		
Total Claims	14 - 20 =	0	X \$ 18.00	\$	0
Independent Claims	1 - 3 =	0	X \$ 78.00	\$	0
Multiple dependent claim(s) (if applicable)			+ \$260.00	\$	260.00
<b>TOTAL OF ABOVE CALCULATIONS =</b>				\$	1,100.00
Reduction by 1/2 for filing by small entity, if applicable. Verified Small Entity statement must also be filed. (Note 37 CFR 1.9, 1.27, 1.28).				\$	
<b>SUBTOTAL =</b>				\$	1,100.00
Processing fee of \$130.00 for furnishing the English translation later than _ 20 _ 30 months from the earliest claimed priority date (37 CFR 1.492(f)).				\$	
<b>TOTAL NATIONAL FEE =</b>				\$	1,100.00
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). \$40.00 per property				\$	40.00
<b>TOTAL FEES ENCLOSED =</b>				\$	1,100.00
				Amount to be refunded	\$
				Charged	\$
a. <u>XX</u> A check in the amount of \$ <u>1,140.00</u> to cover the above fees is enclosed. b. <u>   </u> Please charge my Deposit Account No. <u>01-2300</u> in the amount of \$ <u>      </u> to cover the above fees. A duplicate copy of this sheet is enclosed. c. <u>XX</u> The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. <u>01-2300</u> .					
<b>NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.</b>					
SEND ALL CORRESPONDENCE TO:					
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CMM:mgg					

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:

Toshio YAMAGIWA

Serial No.: New Application

Group Art Unit:

Filed: September 14, 2000

Examiner:

For: SEALANT-INCORPORATED TIRE MANUFACTURING  
METHOD AND SEALANT-INCORPORATED TIRE

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents  
Washington, D.C. 20231

September 14, 2000

Sir:

Prior to examination of this application, please amend the above-identified application as follows:

IN THE SPECIFICATION:

Please amend the specification as follows:

Page 8, line 8, delete "Fig. 11" and substitute therefor – Figs. 11A and 11B –.

REMARKS

The above amendments to the specification have been made in order to place the Brief Description of the Drawings in the specification into conformance with the drawings being filed with the application.

In the event that any fees are due in connection with this paper, please charge our  
Deposit Account No. 01-2300.

Respectfully submitted,

ARENT FOX KINTNER PLOTKIN & KAHN, PLLC



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SPECIFICATION (originally filed)

SEALANT-INCORPORATED TIRE MANUFACTURING METHOD AND  
SEALANT-INCORPORATED TIRE

5 FIELD OF THE INVENTION

The present invention relates to a manufacturing method for a sealant-incorporated tire having an annular sealant chamber defined by an inner liner inside a tread, and relates also to a sealant-incorporated tire manufactured by this method.

PRIOR ART

A sealant-incorporated tire is known from Japanese Patent Application Laid-open No. 8-323875, for example. This sealant-incorporated tire has a sealant chamber at least a part of which is defined by an inner liner inside a tread of a tire body. The sealant chamber is filled with a sealant for sealing a puncture formed through the tread by a nail or the like to thereby delay air leakage from the puncture.

In manufacturing the above conventional sealant-incorporated tire, the inner liner is superposed onto the tire body prior to vulcanization. At this time, a mold release agent such as talc is preliminarily applied to a part of the contact surfaces of the inner liner and the tire body or to a part of the contact surfaces of inner

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liner elements forming the inner liner. In this condition, vulcanization is performed to integrate the inner liner with the tire body and form the sealant chamber by leaving the portion to which the mold release agent is applied unbonded.

It should be noted here that in performing vulcanization by inserting a green tire including a tire body and an inner liner into a heating die, the inner liner is expanded to produce an area where the density of talc as the mold release agent is high and an area where it is low. As a result, the boundary between a bonded portion and an unbonded portion of the inner liner in the vulcanization process is not clearly defined, so that there is a possibility that the shape of the resultant sealant chamber may become imperfect. Accordingly, there is a problem that it is difficult to form a sealant chamber having a desired shape, and the degree of freedom in designing the shape of the sealant chamber is limited.

#### DISCLOSURE OF THE INVENTION

The present invention has been accomplished with the above circumstances in view, and it is an object of the present invention to clearly define the boundary between the bonded portion and the unbonded portion of the inner liner in vulcanizing the green tire, thereby forming a sealant chamber having a proper shape.

To accomplish the above-described object, according to a first aspect and feature of the present invention, there is provided a sealant-incorporated tire manufacturing method comprising the steps of superposing  
5 an inner liner onto an inner surface of a tire body prior to vulcanization and bonding at least a part of the inner liner to the inner surface of the tire body by vulcanization to define an annular sealant chamber by the inner liner inside a tread of the tire body, in which a  
10 mold release sheet having a mold releasing property is placed on a portion of the inner liner facing to the sealant chamber prior to vulcanization.

With the above arrangement, the mold release sheet having the mold releasing property is placed on a portion  
15 of the inner liner facing to the sealant chamber in superposing the inner liner onto the inner surface of the tire body prior to vulcanization. Accordingly, this portion of the inner liner facing to the sealant chamber can reliably be prevented from being bonded by  
20 vulcanization to the inner surface of the tire body, and the remaining portion of the inner liner not facing to the sealant chamber can reliably be bonded by vulcanization to the inner surface of the tire body. As a result, the degree of freedom in designing the shape of  
25 the sealant chamber can be improved, and the sealant

chamber can be formed into a proper shape.

According to a second aspect and feature of the present invention in addition to the above arrangement, there is provided a sealant-incorporated tire manufacturing method, wherein at least a part of one surface of the mold release sheet has the mold releasing property, and, in the vulcanization step, a part of the mold release sheet which has no mold releasing property is bonded to a wall surface of the sealant chamber by vulcanization.

With the above arrangement, the mold release sheet has a portion having the mold releasing property and a portion having no mold releasing property. The portion having the mold releasing property can prevent bonding of the inner liner to a part of the inner surface of the tire body by vulcanization to thereby form the sealant chamber. The portion having no mold releasing property allows the inner liner to be bonded to the wall surface of the sealant chamber by vulcanization to prevent random movement of the inner liner. Further, by setting the portion having the mold releasing property into a part of the one surface of the mold release sheet, the other part of the one surface can be used to bond the inner liner to the inner surface of the tire body by vulcanization, thereby stabilizing the shape of the sealant chamber.



According to a third aspect and feature of the present invention in addition to the first aspect and feataure, there is provided a sealant-incorporated tire manufacturing method, in which the mold release sheet is  
5 formed of a material soluble in a sealant, so that the mold release sheet is dissolved into the sealant by injecting the sealant into the sealant chamber.

With the above arrangement, if the sealant is injected into the sealant chamber, the mold release sheet  
10 is dissolved into the sealant. Accordingly, a reduction in sealability of the sealant due to the presence of the mold release sheet in the sealant chamber can reliably be prevented.

According to a fourth aspect and feature of the  
15 present invention in addition to the third aspect and feature, there is provided a sealant-incorporated tire manufacturing method, in which the mold release sheet is formed of water-soluble paper or non-woven fabric.

With the above arrangement, the mold release sheet  
20 can reliably be dissolved into the sealant by injecting the sealant into the sealant chamber.

According to a fifth aspect and feature of the present invention in addition to the third aspect and  
25 feature, there is provided a sealant-incorporated tire manufacturing method, in which the mold release sheet is

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a film formed of a natural polysaccharide.

With the above arrangement, the mold release sheet can reliably be dissolved into the sealant by injecting the sealant into the sealant chamber.

5 According to a sixth aspect and feature of the present invention in addition to the first aspect and feature, there is provided a sealant-incorporated tire manufacturing method, in which a plurality of mold release sheets are laminated one on another.

10 With the above arrangement, even if the mold release sheets are expanded with the tire body and the inner liner in the vulcanization step, the contact surfaces of the plural mold release sheets mutually slide to thereby prevent breaking of the mold release sheets.

15 Accordingly, undesired bonding of the tire body and the inner liner by vulcanization can reliably be avoided.

According to a seventh aspect and feature of the present invention in addition to the first aspect and feature, there is provided a sealant-incorporated tire  
20 manufacturing method, wherein the mold release sheet is folded into a corrugated shape prior to vulcanization, and the mold release sheet is expanded in the vulcanization step.

With the above arrangement, even if the mold  
25 release sheets are expanded with the tire body and the

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inner liner in the vulcanization step, the corrugated mold release sheet which is folded into a corrugated shape is freely expanded, so that it is prevented from being broken. Accordingly, undesired bonding of the tire body and the inner liner by vulcanization can reliably be avoided.

According to an eighth aspect and feature of the present invention, there is provided a sealant-incorporated tire which is manufactured by the sealant-incorporated tire manufacturing method according to any one of the first to seventh aspects and features.

With the above arrangement, it is possible to provide a high-quality sealant-incorporated tire having a sealant chamber proper in shape.

#### BRIEF DESCRIPTION OF THE DRAWINGS

Figs. 1 to 5 show a first embodiment of the present invention, wherein Fig. 1 is a laterally sectional view of a motorcycle wheel mounted with a tire; Fig. 2 is a first part of a flow diagram showing a manufacturing method for the tire; Fig. 3 is a second part of the flow diagram; Fig. 4 is an enlarged cross-sectional view taken along a line 4-4 in Fig. 2; Fig. 5 is an enlarged cross-sectional view taken along a line 5-5 in Fig. 3; Fig. 6 is a laterally sectional view of a motorcycle wheel mounted with a tire according to a second embodiment of

the present invention; Fig. 7 is a sectional view similar to Fig. 4, according to the second embodiment; Fig. 8 is a laterally sectional view of a motorcycle wheel mounted with a tire according to a third embodiment of the present invention; Fig. 9 is a sectional view similar to Fig. 4, according to the third embodiment; Fig. 10 is a sectional view similar to Fig. 4, according to a fourth embodiment of the present invention; Fig. 11 are sectional views respectively showing a condition where a tire vulcanizing step is finished and a condition where a sealant injecting step is finished, according to the fourth embodiment; Fig. 12 is a sectional view similar to Fig. 4, according to a fifth embodiment of the present invention. Figs. 13 to 19 show a first method of forming a sealant chamber by using a liquid mold release agent, wherein Fig. 13 is a laterally sectional view of a motorcycle wheel mounted with a tire manufactured by the first method; Fig. 14 is a first part of a flow diagram showing a manufacturing method for the tire; Fig. 15 is a second part of the flow diagram; Fig. 16 is an enlarged view taken in the direction of an arrow 16 in Fig. 14; Fig. 17 is a view taken in the direction of a line 17-17 in Fig. 16; Fig. 18 is an enlarged cross-sectional view taken along a line 18-18 in Fig. 14; and Fig. 19 is an enlarged cross-sectional view taken along a line 19-19 in

Fig. 15. Fig. 20 is a view similar to Fig. 14, showing a second method of forming a sealant chamber by using a liquid mold release agent.

#### BEST MODE FOR CARRYING OUT THE INVENTION

5 Hereinafter, a first embodiment of the present invention will be described with reference to Figs. 1 to 5.

As shown in Fig. 1, mounted on a rim R of a motorcycle wheel is a tubeless tire T including a tire  
10 body 1 and an inner liner 2 bonded to an inner portion of the tire body 1 by vulcanization. The inner liner 2 is bonded by vulcanization at its right and left side portions except its central portion to an inner surface of the tire body 1, so that an air chamber 5 having a  
15 substantially circular shape in section is defined inside the inner liner 2, and a sealant chamber 6 having a substantially arcuate shape in section is defined between a non-bonded portion of the inner liner 2 and the inner surface of the tire body 1. The sealant chamber 6 is  
20 filled with a known liquid sealant 7.

The rim R includes an annular rim body 11 extending in the circumferential direction of the tire T and a pair of flanges 12, 12 extending radially outward from the laterally opposite ends of the rim body 11 to hold the  
25 inner circumference of the tire body 1. An air valve 13

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for charging air into the air chamber 5 defined inside the inner liner 2 is supported through an air valve mounting portion 14 formed in one portion in the circumferential direction of the rim body 11.

5 The sealant chamber 6 defined between the inner liner 2 and the tire body 1 is maintained in a shape along an inner circumference of a tread 15 by air pressure in the air chamber 5. Accordingly, even when the tire body 1 is punctured by a nail or the like in the radial direction of the tire T or from a side portion of the tread 15, a puncture formed through the tire body 1 is immediately filled and mended with the sealant 7, thereby delaying air leakage from the air chamber 5 through the puncture. Further, since the sealant 7 is 15 kept contained in the sealant chamber 6 and does not enter the air chamber 5, there is no possibility that the air valve 13 or a pressure gauge and the like put to the air valve 13 may be clogged with the sealant 7.

20 A manufacturing method for the tire T will now be described with reference to Figs. 2 and 3.

The manufacturing method for the tire T includes an inner liner wrapping step, mold release sheet wrapping step, green tire wrapping step, die setting step, vulcanizing step, sealant injecting step, and inspecting 25 step.

In the inner liner wrapping step, the cylindrical inner liner 2 of raw rubber is fitted around the outer circumference of a drum 23. In the subsequent mold release sheet wrapping step, a mold release sheet 9 is wrapped around the outer circumference of the inner liner 2. In the green tire wrapping step, each component of the tire body 1 is wrapped around the outer circumferences of the inner liner 2 and the mold release sheet 9 to form a green tire 24.

Fig. 4 shows a lateral cross section of the green tire 24 wrapped around the drum 23. The inner liner 2 forming the innermost layer of the green tire 24 has a width  $W_1$ , and the mold release sheet 9 stacked on the outer surface of the inner liner 2 has a width  $W_2$  smaller than the width  $W_1$  of the inner liner 2. Accordingly, the inner liner 2 partially projects from the opposite side edges of the mold release sheet 9. The mold release sheet 9 is formed from a fluoro resin sheet (e.g., Teflon sheet) or a silicone resin sheet having a thickness of 50  $\mu$  m or less, which are commercially available. For example, Aflex (trade name) manufactured by Asahi Glass Co., Ltd. may be used as the Teflon sheet.

One surface of the mold release sheet 9 is preliminarily subjected to corona discharge treatment or CS treatment, so as to eliminate surface lubrication and

thereby enhance adhesion to rubber. This treated surface of the mold release sheet 9 is brought into contact with the tire body 1, and the other untreated surface having the mold releasing property is brought into contact with the inner liner 2.

The corona discharge treatment is performed by generating high-voltage corona discharge between an electrode connected to a high-voltage generator and a metal roll of which surface is coated with polyester, Hypalon, EP rubber, etc. while passing the mold release sheet 9 as a subject to be treated along the metal roll to thereby make ozone or nitrogen oxide that has created corona react with the exposed surface of the mold release sheet 9, thereby making this surface hydrophilic because of generation of resultant carbonyl groups or the like. The CS treatment is performed by carrying out plasma discharge treatment under vacuum instead of the corona discharge, and the function and effect similar to those of the corona discharge treatment can be obtained.

The tire body 1 of raw rubber is wrapped around the outer circumferences of the inner liner 2 and the mold release sheet 9 to form the green tire 24. The tire body 1 is comprised of a cord portion 25 wrapped around the radially outside of the inner liner 2 and the mold release sheet 9, a pair of bead portions 26, 26 fitted



with the outer circumference of the inner liner 2 so as to be joined with axially opposite ends of the cord portion 25, and a tread portion 27 wrapped around the radial outside of the cord portion 25 and the bead portions 26, 26 so as to cover them.

Subsequently, in the die setting step, the green tire 24 removed from the drum 23 is set between an upper die 29 and a lower die 30 for vulcanization and forming. Further, in the vulcanizing step as shown in Fig. 5, the upper die 29 and the lower die 30 are heated, and a pressure bag 31 placed inside the green tire 24 is expanded by air pressure to thereby bring the green tire 24 into pressure contact with the inner forming surfaces of the upper die 29 and the lower die 30, thus vulcanizing and forming the green tire 24 into a final product shape. By this vulcanization and forming, the inner liner 2 is integrated with the tire body 1.

At this time, the mold release sheet 9 is sandwiched and is compressed between the inner liner 2 and the tire body 1 by the pressure from the pressure bag 31 expanded. However, the other surface (i.e., the untreated surface) of the mold release sheet 9 abutting against the inner liner 2 is not bonded to the inner liner 2 by vulcanization, but the one surface (i.e., the treated surface) of the mold release sheet 9 abutting

against the tire body 1 is bonded to the tire body 1 by vulcanization.

Thus, a portion of the inner liner 2 that must be bonded to the tire body 1 by vulcanization can reliably be bonded by vulcanization, and a portion of the inner liner 2 that must not be bonded to the tire body 1 by vulcanization can reliably remain in the non-bonded state by using the mold release sheet 9, thereby forming the sealant chamber 6 having a proper shape between the inner liner 2 and the tire body 1. Furthermore, since the mold release sheet 9 is bonded and fixed to the inner surface of the tire body 1 by vulcanization, there is no possibility that the mold release sheet 9 may move in the sealant chamber 6 at random to hinder the free flow of the sealant 7, thereby reliably exhibiting a sealing effect by the sealant.

After the vulcanization and forming, the tire body 1 and the inner liner 2 integrated together are removed from the upper and lower dies. In the next sealant injecting step, the sealant 7 is injected into the sealant chamber 6 by using an injector or the like, thus completing the tire T. In the final inspecting step, the completed tire T is inspected to terminate all the steps.

A second embodiment of the present invention will now be described with reference to FIGS. 6 and 7.

As shown in Fig.6, a tire T according to the second embodiment includes a first inner liner 2<sub>1</sub> bonded by vulcanization to a radially outside portion of an inner surface of a tire body 1, and a second inner liner 2<sub>2</sub> bonded by vulcanization to a radially inside portion of the inner surface of the tire body 1 and to right and left opposite end portions of the first inner liner 2<sub>1</sub>. A sealant chamber 6 is defined between the first inner liner 2<sub>1</sub> and the second inner liner 2<sub>2</sub>. A mold release sheet 9 is fixed by vulcanization and bonding to a wall surface of the first inner liner 2<sub>1</sub> facing to the sealant chamber 6.

Fig. 7 shows a green tire wrapping step for the tire T according to the second embodiment. A second inner liner 2<sub>2</sub> is wrapped around an outer circumference of a drum 23, a mold release sheet 9 is wrapped around the outer circumference of the second inner liner 2<sub>2</sub>, and a first inner liner 2<sub>1</sub> is wrapped around the mold release sheet 9. A surface of the mold release sheet 9 opposed to the first inner liner 2<sub>1</sub> is preliminarily subjected to corona discharge treatment or CS treatment, and this treated surface of the mold release sheet 9 is bonded by vulcanization to the first inner liner 2<sub>1</sub>. A surface of the mold release sheet 9 opposed to the second inner liner 2<sub>2</sub> exhibits its mold releasing property to define

A third embodiment of the present invention will now be described with reference to Figs. 8 and 9.

Fig. 9 shows a green tire wrapping step for the tire T according to the third embodiment. The inner liner 2 is wrapped around an outer circumference of a drum 23, and two mold release sheets 9, 9 are wrapped around the outer circumference of the inner liner 2 so as to be

spaced apart from each other by a distance of 5 mm. Further, each component of the tire body 1 is wrapped around the outer circumference of the inner liner 2, thus forming the green tire 24. A surface of each of the mold release sheets 9, 9 opposed to the inner liner 2 has a mold releasing property, and a surface of each of the mold release sheets 9, 9 opposed to the tire body 1 is preliminarily subjected to corona discharge treatment or CS treatment to lose its mold releasing property. Accordingly, each of the two separate sealant chambers 6, 6 can be formed into a proper shape.

Incidentally, while the two mold release sheets 9, 9 are laterally spaced apart from each other in manufacturing the tire T having the structure shown in Fig. 8 according to the third embodiment, a single mold release sheet 9 may be used by the following two methods to obtain a similar effect.

According to the first method, the entirety of the surface of the mold release sheet 9 opposed to the tire body 1 is preliminarily subjected to corona discharge treatment or CS treatment to eliminate its mold releasing property, and a part of the surface of the mold release sheet 9 opposed to the inner liner 2 is preliminarily subjected to corona discharge treatment or CS treatment to eliminate its mold releasing property. Accordingly, a

part of the surface opposite to the surface of the mold release sheet 9 bonded to the tire body 1 is bonded to the inner liner 2, thereby obtaining the tire T having the structure as shown in Fig. 8. The part, of which mold releasing property is eliminated, of the surface of the mold release sheet 9 opposed to the liner 2 may be in the form of lines or spots.

According to the second method, the surface of the mold release sheet 9 opposed to the tire body 1 is preliminarily subjected to corona discharge treatment or CS treatment to eliminate its mold releasing property, and slits or spot openings are then formed through the mold release sheet 9. Accordingly, the inner liner 2 is brought into contact with the tire body 1 through the above slits or spot openings of the mold release sheet 9, and is bonded by vulcanization to the tire body 1, thereby obtaining the tire T having the structure as shown in Fig. 8.

A fourth embodiment of the present invention will now be described with reference to FIGS. 10 and 11.

In contrast with the first to third embodiments each employing the single mold release sheet 9, according to the fourth embodiment, three mold release sheets 9<sub>1</sub>, 9<sub>2</sub>, and 9<sub>3</sub> are positioned in a laminated state between a first inner liner 2<sub>1</sub> and a second inner liner 2<sub>2</sub> in the

condition of a green tire 24, as shown in Fig. 10. Each of the three mold release sheets 9<sub>1</sub>, 9<sub>2</sub>, and 9<sub>3</sub> is formed of a material soluble in a sealant 7 composed mainly of water and ethylene glycol. Examples of this material include water-soluble paper, non-woven fabric, edible film and the like. The edible film is a film formed mainly of carrageenan as a natural polysaccharide extracted from the seaweed, and this film is soluble in water, so that it is soluble in the sealant 7.

By laminating the three mold release sheets 9<sub>1</sub>, 9<sub>2</sub>, and 9<sub>3</sub> one on another as described above, it is possible to avoid a break of these sheets 9<sub>1</sub>, 9<sub>2</sub>, and 9<sub>3</sub> in a vulcanizing step wherein the green tire 24 is set between an upper die 29 and a lower die 30 and vulcanized while heating to be formed into a final product shape, thereby reliably preventing a possibility of bonding of the first inner liner 2<sub>1</sub> and the second inner liner 2<sub>2</sub> by vulcanization. More specifically, the mold release sheets 9<sub>1</sub>, 9<sub>2</sub>, and 9<sub>3</sub> are expanded with the green tire 24 in opposite directions shown by arrows a-a in FIG. 11(A) in the vulcanizing step. At this time, the mold release sheets 9<sub>1</sub>, 9<sub>2</sub>, and 9<sub>3</sub> slide mutually to be prevented from breaking, so that there is no possibility of direct contact of the first inner liner 2<sub>1</sub> and the second inner liner 2<sub>2</sub> in the broken portion. More preferably, talc is

attached to opposite surfaces of the central mold release sheet 9<sub>2</sub>, thereby improving the mutual slide of the mold release sheets 9<sub>1</sub>, 9<sub>2</sub>, and 9<sub>3</sub> to more reliably prevent the break.

5           Thereafter, the sealant 7 is injected into the sealant chamber 6. Because the mold release sheets 9<sub>1</sub>, 9<sub>2</sub>, and 9<sub>3</sub> remaining in the sealant chamber 6 are dissolved as shown in Fig. 11B, the sealability of the sealant 7 can reliably be prevented from being hindered by the  
10 remaining of the mold release sheets 9<sub>1</sub>, 9<sub>2</sub>, and 9<sub>3</sub>.

A fifth embodiment of the present invention will now be described with reference to FIG. 12.

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15           The fifth embodiment is characterized in that one (e.g., the central mold release sheet 9<sub>2</sub>) of the three mold release sheets 9<sub>1</sub>, 9<sub>2</sub>, and 9<sub>3</sub> used in the fourth embodiment is preliminarily formed into a corrugated shape. With this configuration, even if the upper and lower mold release sheets 9<sub>1</sub> and 9<sub>3</sub> are broken in the vulcanizing step wherein the green tire 24 and the three  
20 mold release sheets 9<sub>1</sub>, 9<sub>2</sub>, and 9<sub>3</sub> are expanded so that the green tire 24 is formed into a final product shape, the corrugated mold release sheet 9<sub>2</sub> is expanded to become linear and is prevented from being broken, thereby reliably preventing direct contact of the first inner  
25 liner 2<sub>1</sub> and the second inner liner 2<sub>2</sub> to prevent bonding



of these inner liners 2<sub>1</sub> and 2<sub>2</sub> by vulcanization.

Having thus described the embodiments of the present invention, various design changes may be made without departing from the scope of the present invention.

5 For example, the mold release sheets 9, 9<sub>1</sub>, 9<sub>2</sub>, 9<sub>3</sub> in each of the first to third and fifth embodiments may be formed of a material soluble in the sealant 7. Further, while the three mold release sheets 9<sub>1</sub>, 9<sub>2</sub>, and 9<sub>3</sub> are laminated one on another in each of the fourth and fifth  
10 embodiments, two mold release sheets or four or more mold release sheets may be laminated one on another.

While the mold release sheets 9, 9<sub>1</sub>, 9<sub>2</sub>, and 9<sub>3</sub> are used to form the sealant chamber 6 in the first to fifth  
15 embodiments, there will now be described some methods of forming a sealant chamber by using a liquid mold release agent instead of the mold release sheets 9, 9<sub>1</sub>, 9<sub>2</sub>, and 9<sub>3</sub>.

Hereinafter, a first method of forming a sealant chamber by using a liquid mold release agent will be described with reference to Figs. 13 to 19.

20 As shown in FIG. 13, mounted on a rim R of the motorcycle wheel is a tubeless tire T including a tire body 1 and an inner liner 2 bonded to an inner portion of the tire body 1 by vulcanization. The inner liner 2 includes a sectionally substantially U-shaped peripheral  
25 wall 3 which is comprised of air chamber peripheral walls

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tread 15 by air pressure in the air chamber 5. Accordingly, even when the tire body 1 is punctured by a nail or the like in the radial direction of the tire T or from a side portion of the tread 15, a puncture formed through the tire body 1 is immediately filled and mended with the sealant 7, thereby delaying air leakage from the air chamber 5 through the puncture. Further, since the sealant 7 is kept contained in the sealant chamber 6 and does not enter the air chamber 5, there is no possibility that the air valve 13 or a pressure gauge and the like put to the air valve 13 may be clogged with the sealant 7.

A manufacturing method for the tire T will now be described with reference to Figs. 14 and 15.

The manufacturing method for the tire T includes a material kneading step, inner liner extrusion molding step, cutting step, cut-opening step, hole making step, joining step, liquid mold release agent injecting step, drum wrapping step, green tire molding step, die setting step, vulcanizing step, sealant injecting step, hole closing step, and inspecting step.

A material kneaded in the material kneading step is extrusion-molded in the inner liner extrusion molding step to mold the inner liner 2 of raw rubber. The inner liner 2 is integrally comprised of a sealant chamber peripheral wall forming a peripheral wall 3 (see Fig. 13),

a pair of air chamber peripheral walls 3i, 3i and a partition wall 4. The sealant chamber peripheral wall 3o and the partition wall 4 are connected to form a sectionally circular shape, and the pair of air chamber walls 3i, 3i are connected to a connecting portion. In the next cutting step, the inner liner 2 is cut into a given length. In the next hole making step, an injection hole 8 is opened through the partition wall 4 of the inner liner 2.

In the next joining step, the opposite end portions of the inner liner 2 cut in the cutting step are joined together to form an annular shape. As shown in Figs. 16 and 17, the cut opposite end portions of the inner liner 2 are held by a pair of holders 19 to be jointed to each other. Each holder 19 is comprised of an upper die 20 and a lower die 21 which are capable of being relatively opened and closed. The upper die 20 and the lower die 21 have opposed surfaces formed with holding surfaces 20<sub>1</sub> and 21<sub>1</sub> of shallow recess shape, respectively, to hold the inner liner 2 in a flatly compressed state. The sealant chamber peripheral wall 3o of the inner liner 2 is fitted with the holding surface 20<sub>1</sub> of the upper die 20, and the air chamber peripheral walls 3i, 3i and the partition wall 4 of the inner liner 2 are fitted with the holding surface 21<sub>1</sub> of the lower die 21.

In the next liquid mold release agent injecting step, a liquid mold release agent 9 is injected from the injection hole 8 of the partition wall 4 of the inner liner 2 into the sealant chamber 6. In the next drum wrapping step, the annular inner liner 2 having the liquid mold release agent 9 contained in the sealant chamber 6 in the liquid mold release agent injecting step is fitted around the outer circumference of a drum 23. In the next green tire molding step, each component of the tire body 1 is wrapped around the outer circumference of the inner liner 2 to form a green tire 24.

As shown in FIG. 18, the green tire 24 is comprised of a cord portion 25 wrapped around the radially outside of the inner liner 2, a pair of bead portions 26, 26 fitted with the drum 23 so as to be joined with the axially opposite ends of the cord portion 25, and a tread portion 27 wrapped around the radially outside of the cord portion 25 and the bead portions 26 so as to cover them.

In the die setting step, the green tire 24 removed from the drum 23 is set between an upper die 29 and a lower die 30 for vulcanization and forming. In the vulcanizing step as shown in FIG. 19, the upper die 29 and the lower die 30 are heated, and a pressure bag 31 placed inside the green tire 24 is expanded by air



and the partition wall 4 can be formed into a proper shape.

The total thickness of the sealant chamber peripheral wall 3o and the partition wall 4 of the inner liner 2 is larger than the thickness of each of the air chamber peripheral walls 3i, 3i, so that steps are generated at the opposite ends of the partition wall 4 (see an enlarged encircled portion in FIG. 19). To absorb the above-described steps, the outer surface of the pressure bag 3l is formed with a step portion 3l<sub>1</sub>, thereby pressing the sealant chamber peripheral wall 3o, the partition wall 4, and the air chamber peripheral walls 3i, 3i to the inner surface of the tire body 1 under a uniform pressure.

After the vulcanizing step, the tire body 1 and the inner liner 2 integrated together are removed from the upper and lower dies. In the next sealant injecting step, the sealant 7 is injected from the injection hole 8 of the partition wall 4 into the sealant chamber 6. In the next hole closing step, an adhesive tape 32 is attached to the injection hole 8, thus completing the tire T. In the final inspecting step, the tire T completed is inspected to terminate all the steps.

A second method of forming a sealant chamber by using a liquid mold release agent will now be described

with reference to FIG. 20.

This method is characterized in the shape of an inner liner 2, extrusion-molded in the inner liner extruding step. More specifically, the inner liner 2 integrally has a sectionally circular peripheral wall 3 and a sectionally S-shaped partition wall 4 dividing the peripheral wall 3 into two parts. In the next cutting step, the inner liner 2 is cut into a given length. In the next cut-opening step, the peripheral wall 3 of the inner liner 2 is cut in its longitudinal direction to thereby form a sealant chamber peripheral wall 3o and a pair of air chamber peripheral walls 3i, 3i. The subsequent steps are similar to those of the first method mentioned above.

In the second method of forming a sealant chamber by using a liquid mold release agent, the inner liner 2 includes a sealant chamber 6 of a bag-shape which is defined by the sealant chamber peripheral wall 3o and the partition wall 4. Alternatively, the sealant chamber 6 may be defined between the inner liner 2 and the inner surface of the tire body 1 by bonding the opposite side edges of a sheet-formed inner liner to the inner surface of the tire body 1 by vulcanization. In this case, the vulcanizing step may be carried out in the state in which the inner liner 2 is superposed onto the inner surface of



the tire body 1, while the liquid mold release agent 9 is preliminarily applied to a portion of the inner liner facing to the sealant chamber 6.

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## WHAT IS CLAIMED IS

1. A sealant-incorporated tire manufacturing method comprising the steps of superposing an inner liner (2, 2<sub>1</sub>, 2<sub>2</sub>) onto an inner surface of a tire body (1) prior to vulcanization and bonding at least a part of said inner liner (2, 2<sub>1</sub>, 2<sub>2</sub>) to the inner surface of said tire body (1) by vulcanization to define an annular sealant chamber (6) by said inner liner (2, 2<sub>1</sub>, 2<sub>2</sub>) inside a tread (15) of said tire body (1), in which a mold release sheet (9, 9<sub>1</sub>, 9<sub>2</sub>, 9<sub>3</sub>) having a mold releasing property is placed on a portion of said inner liner (2, 2<sub>1</sub>, 2<sub>2</sub>) facing to said sealant chamber (6) prior to vulcanization.

2. A sealant-incorporated tire manufacturing method according to claim 1, wherein at least a part of one surface of said mold release sheet (9) has the mold releasing property, and, in the vulcanization step, a part of said mold release sheet (9) which has no mold releasing property is bonded to a wall surface of said sealant chamber (6) by vulcanization.

3. A sealant-incorporated tire manufacturing method according to claim 1, wherein said mold release sheet (9<sub>1</sub>, 9<sub>2</sub>, 9<sub>3</sub>) is formed of a material soluble in a sealant (7), so that said mold release sheet (9<sub>1</sub>, 9<sub>2</sub>, 9<sub>3</sub>) is dissolved into said sealant (7) by injecting said sealant (7) into said sealant chamber (6).

4. A sealant-incorporated tire manufacturing method according to claim 3, wherein said mold release sheet (9<sub>1</sub>, 9<sub>2</sub>, 9<sub>3</sub>) is formed of water-soluble paper or non-woven fabric.

5 5. A sealant-incorporated tire manufacturing method  
according to claim 3, wherein said mold release sheet (9<sub>1</sub>,  
9<sub>2</sub>, 9<sub>3</sub>) is a film formed of a natural polysaccharide.

6. A sealant-incorporated tire manufacturing method according to claim 1, wherein a plurality of mold release sheets (9<sub>1</sub>, 9<sub>2</sub>, 9<sub>3</sub>) are laminated one on another.

7. A sealant-incorporated tire manufacturing method according to claim 1, wherein said mold release sheet (9<sub>2</sub>) is folded into a corrugated shape prior to vulcanization, and said mold release sheet (9<sub>2</sub>) is expanded in the vulcanization step.

8. A sealant-incorporated tire, which is manufactured by the sealant-incorporated tire manufacturing method according to any one of claims 1 to 7.

## ABSTRACT OF THE DISCLOSURE

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A green tire (24) prepared by superposing an inner liner (2) onto the inner surface of a tire body (1) is set in an upper die (29) and a lower die (30). In this condition, a pressure bag (31) placed inside the green tire (24) is expanded by air pressure to perform vulcanization and forming. At this time, a mold release sheet (9) such as a fluoro resin sheet having a mold releasing property on one surface only is interposed between a part of the inner liner (2) and the tire body (1) in such a manner that the surface having the mold releasing property is opposed to the inner liner (2). Accordingly, the inner liner (2) is prevented from being bonded by vulcanization to the tire body (1), thereby forming a sealant chamber having a proper shape for charging a sealant thereto. In case the mold release sheet (9) is formed of a material soluble in the sealant, a reduction in sealability of the sealant due to the mold release sheet (9) left in the sealant chamber can be avoided.

FIG.1

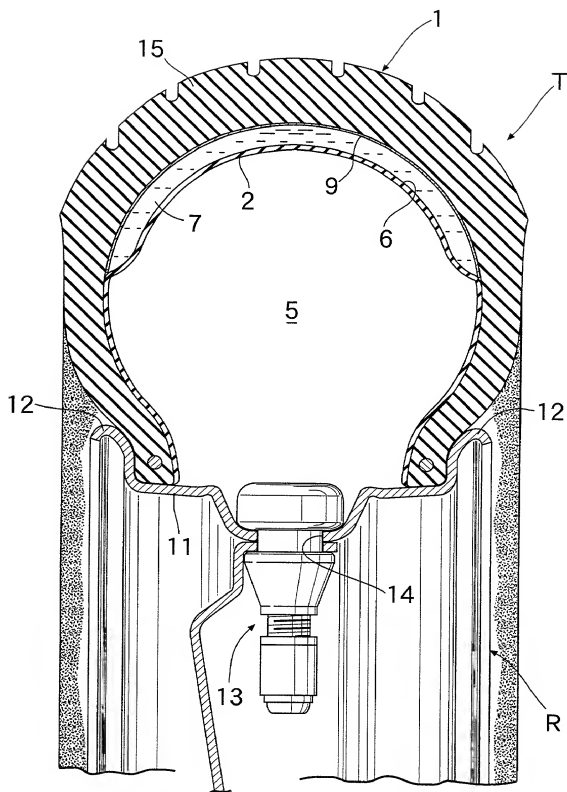


FIG.2

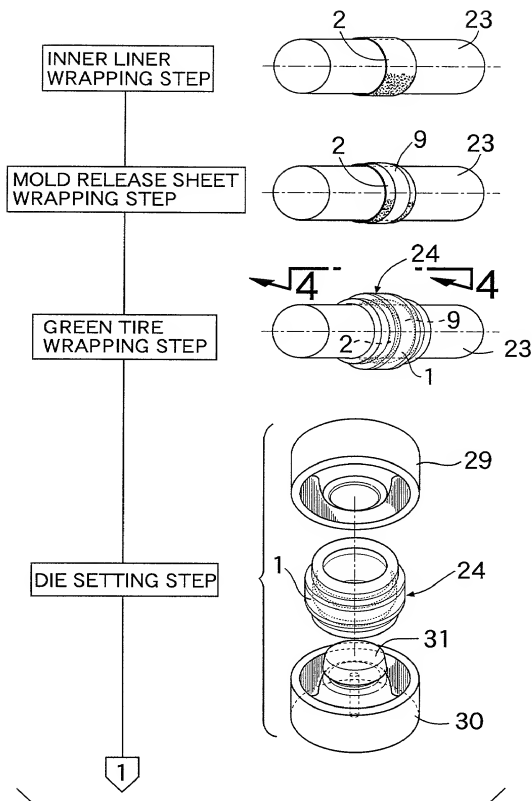


FIG.3

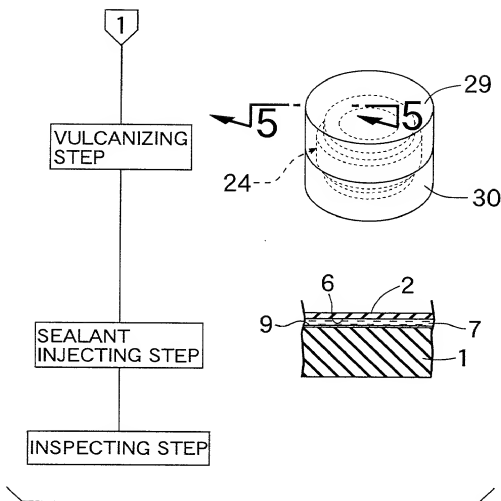


FIG. 4

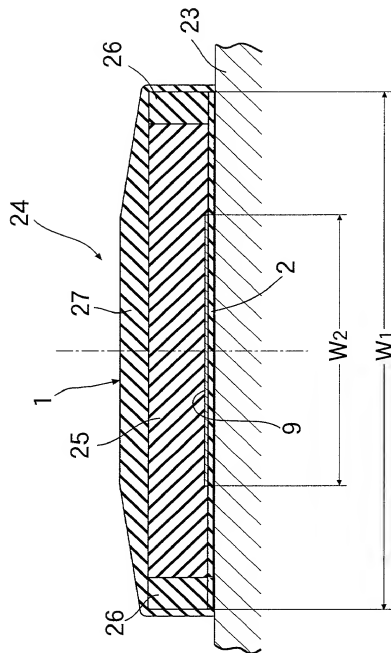
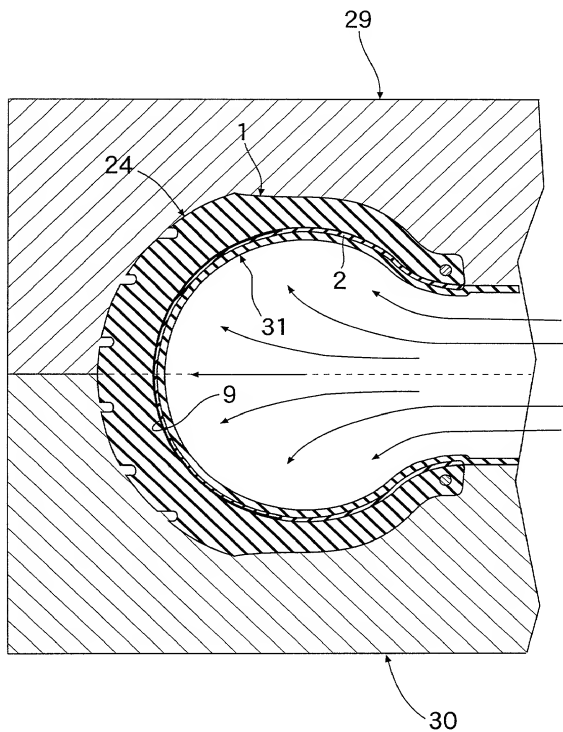




FIG. 5



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FIG. 6

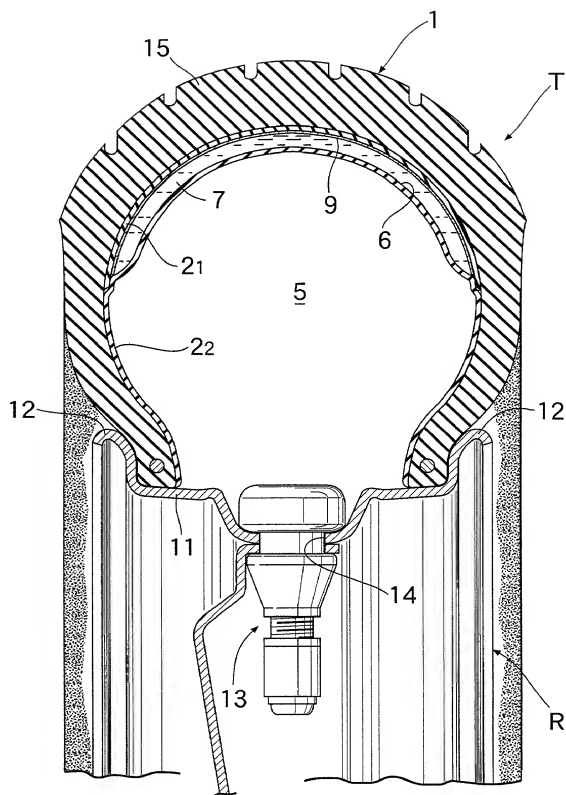


FIG.7

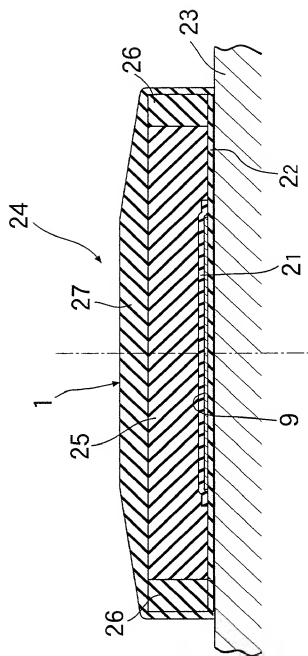
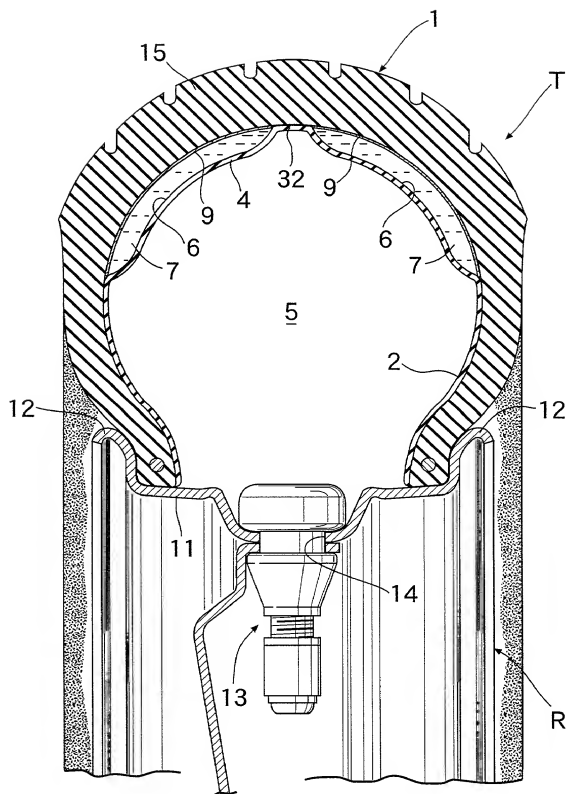


FIG.8



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FIG. 9

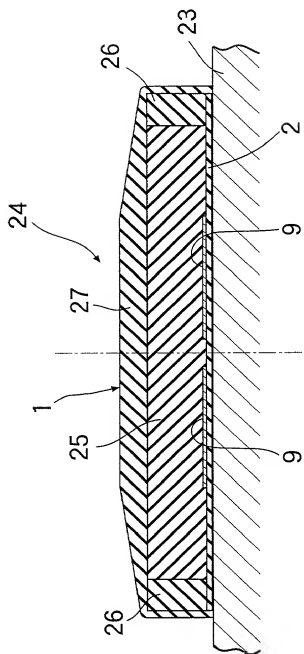


FIG.10

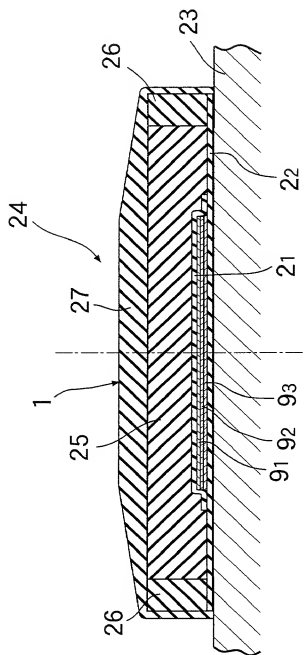


FIG.11A

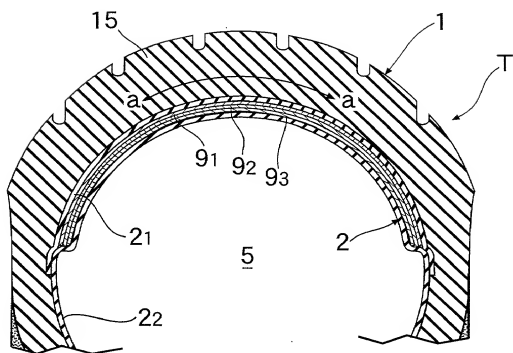


FIG.11B

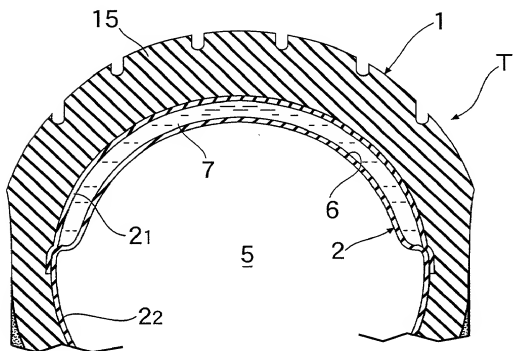






FIG.13

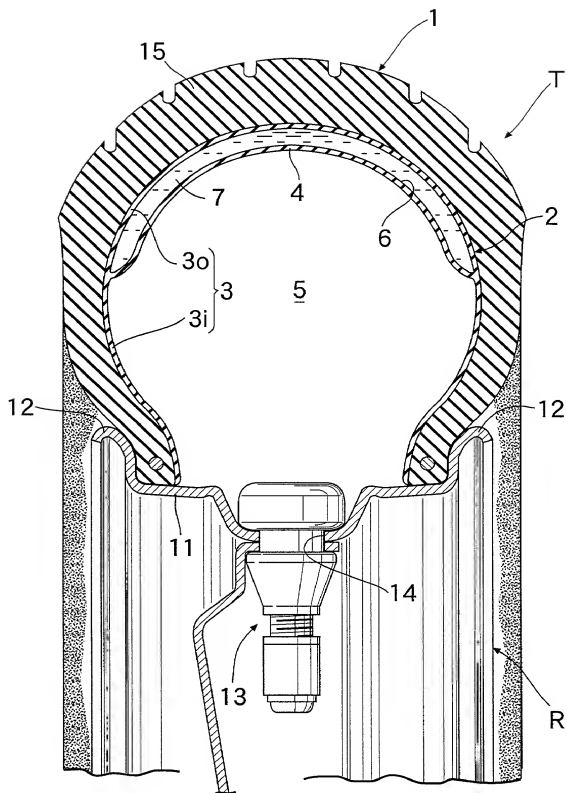


FIG.14

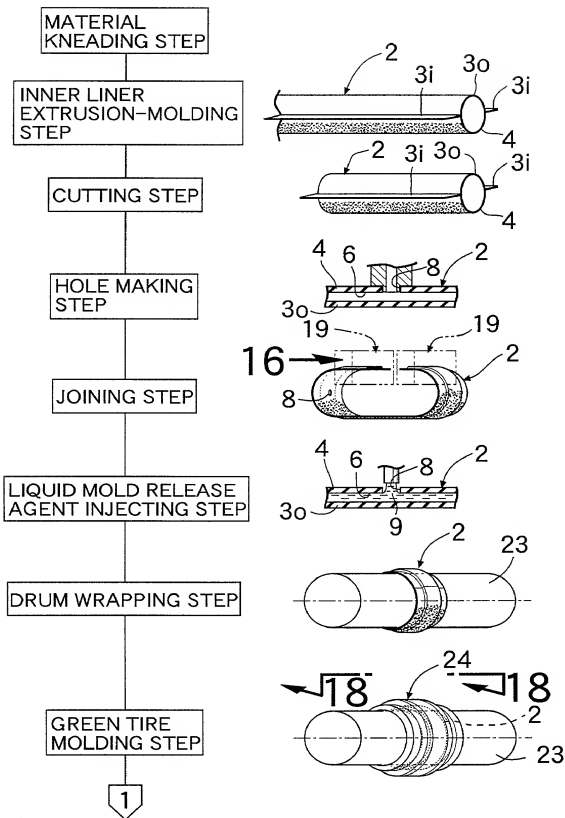


FIG.15

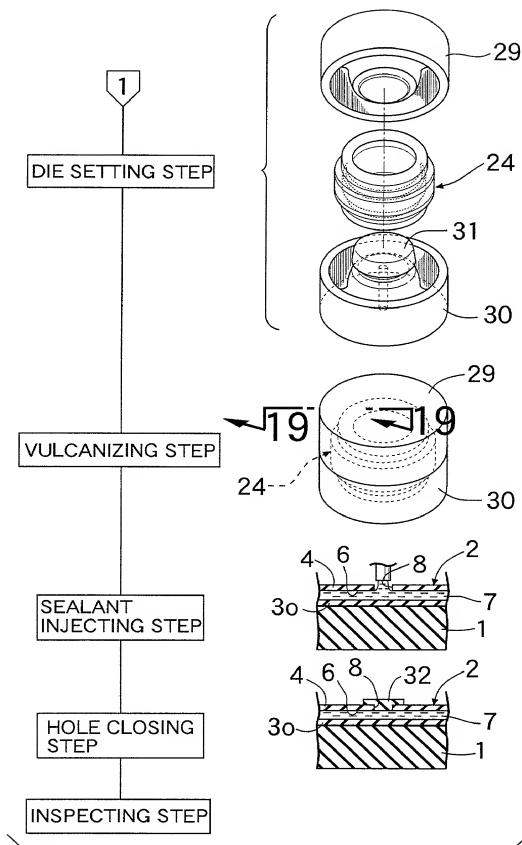


FIG.16

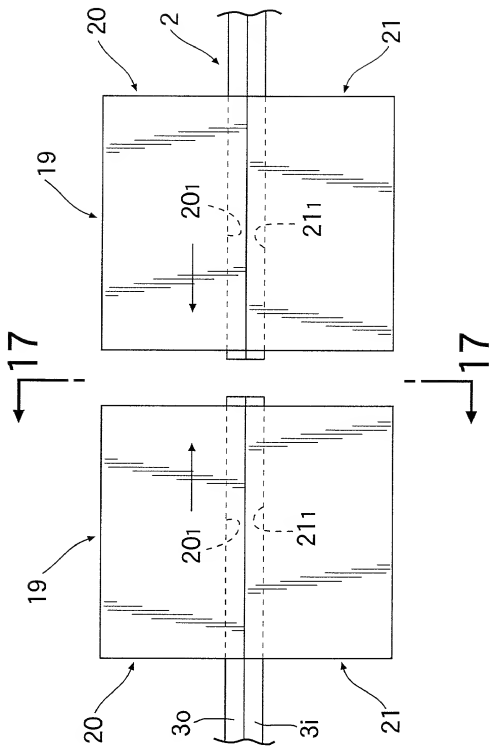


FIG.17

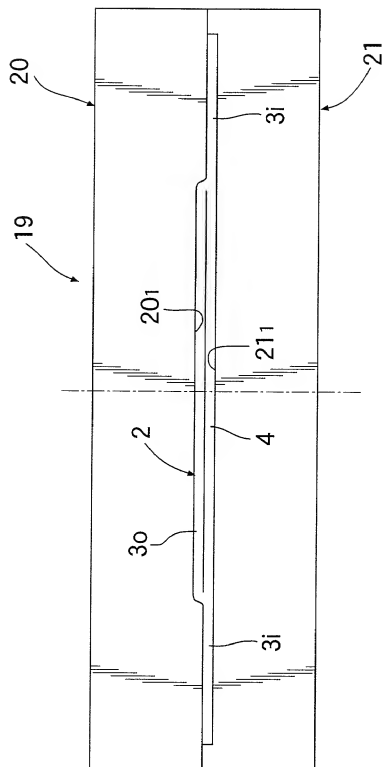


FIG.18

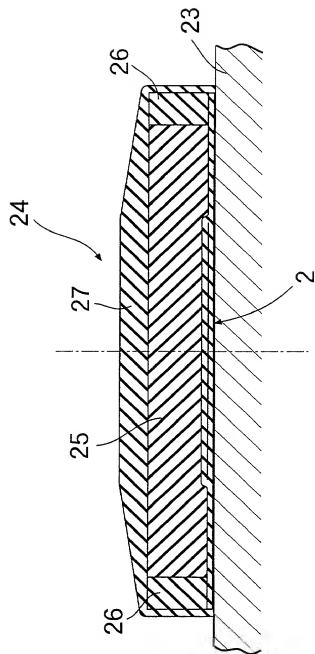


FIG. 19

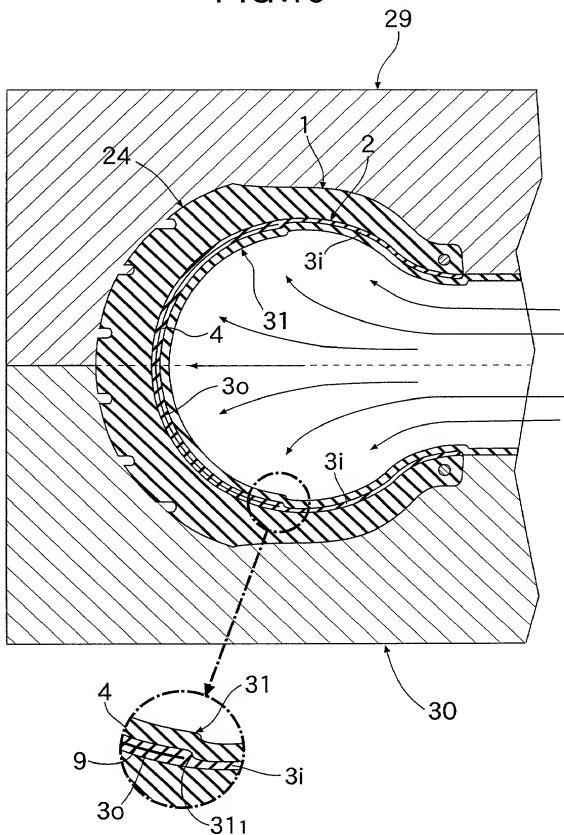
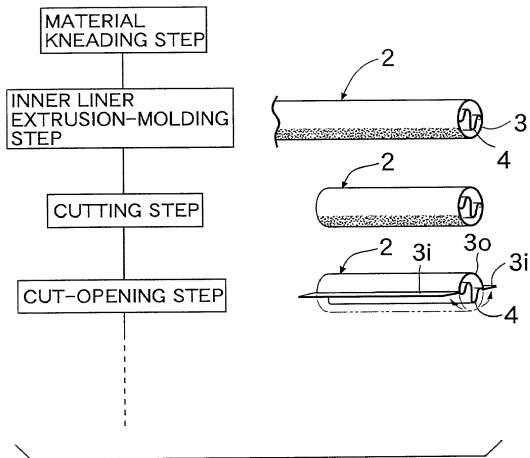


FIG.20





**Declaration For U.S. Patent Application**

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

(Insert Title)

**SEALANT-INCORPORATED TIRE MANUFACTURING METHOD AND  
SEALANT-INCORPORATED TIRE**

the specification of which is attached hereto unless the following box is checked:

☒ was filed on February 8, 1999 as PCT International Application Number PCT/JP99/00528  
and was amended on January 14, 2000 and/or  
was filed on \_\_\_\_\_ as United States Application Number \_\_\_\_\_  
and was amended on \_\_\_\_\_

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claim(s), as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in 37 C.F.R. §1.56.

I hereby claim foreign priority benefits under 35 U.S.C. §119(a)-(d) or §365(b) of any foreign application(s) for patent or inventor's certificate, or §365(a) of any PCT International application which designates at least one country other than the United States, listed below and have also identified below any foreign application(s) for patent or inventor's certificate or PCT International Application having a filing date before that of the application for which priority is claimed:

(List prior foreign applications. See note A on back of this page.)	(Number)	(Country)	(Day/Month/Year Filed)	Priority Claimed <input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
	<u>10-65383</u>	<u>Japan</u>	<u>16 / March / 1998</u>	
	<u>10-206471</u>	<u>Japan</u>	<u>22 / July / 1998</u>	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No
	<u>10-366252</u>	<u>Japan</u>	<u>24 / December / 1998</u>	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> No

I hereby claim the benefit under 35 U.S.C. §119(e) of any United States provisional application(s) listed below.

(Application Number)	(Filing Date)
_____	_____
(Application Number)	(Filing Date)

(See Note B on back of this page.)

☐ See attached list for additional prior foreign or provisional applications.

I hereby claim the benefit under 35 U.S.C. §120 of any United States application(s) or §365(c) of any PCT International application(s) designating the United States of America listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior application(s) (U.S. or PCT) in the manner provided by the first paragraph of 35 U.S.C. §112, I acknowledge the duty to disclose information which is material to patentability as defined in 37 C.F.R. §1.56 which became available between the filing date of the prior application(s) and the national or PCT International filing date of this application:

(List prior U.S. Applications or PCT International applications designating the U.S.)	(Application Serial No.)	(Filing Date)	(Status) (patented, pending, abandoned)
	_____	_____	_____
	(Application Serial No.)	(Filing Date)	(Status) (patented, pending, abandoned)

And I hereby appoint as principal attorneys David T. Nikaido, Reg. No. 22,663; Charles M. Marmelstein, Reg. No. 25,895; George E. Oram, Jr., Reg. No. 27,931; Robert B. Murray, Reg. No. 22,980; E. Marcie Emas, Reg. No. 32,131; Douglas H. Goldhush, Reg. No. 33,125; Monica Chinn Kitts, Reg. No. 36,105; Richard J. Berman, Reg. No. 39,107; King L. Wong, Reg. No. 37,500; Karen K. Costantino, Reg. No. 35,107; James A. Poulos, III, Reg. No. 31,714; Patrick D. Muir, Reg. No. 37,403; Sharon N. Klešner, Reg. No. 36,335; Murat Ozgu, Reg. No. 44,275; Bradley D. Goldizen, Reg. No. 43,637; and N. Alexander Nolte, Reg. No. P45,689.

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

(See Note C on back of this page.)

Full name of sole or first inventor

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August 10, 2000

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